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### Recommended Citation

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## ICT, Creativity and Innovation: How to Design Effective Project Teams

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### Abstract

There are evidences, both from theoretical and managerial perspective, that team creativity is one of success factor for ICT innovative projects. This article focuses on the team design for ICT project, considering the relevance of the collective creative dimension. What is the relationship between individual and collective creativity? How to design and manage creative teams in ICT projects? We developed a wide research programme aiming at going deeper in creativity dynamics to understand what factors and which processes contribute to increase or reduce the creative performance at group level. According to our research aims and considering the review of the specific literature, we designed an experiment. Multiple measures of both individual and group creativity were considered. Results confirmed our main assumption: individual creativity is positively related with group creativity but it does not fully explain it. Moreover, individual creativity has different significant impacts on the three different collective creativity components. Finally, we suggest some practical guidelines for managing an effective creative ICT project team, to support the team members staffing and the group composition.

**Keywords:** creativity, innovation, teamwork

**Permanent URL:** <http://sprouts.aisnet.org/8-44>

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**Reference:** Imperatori, B., Bissola, R. (2008). "ICT, Creativity and Innovation: How to Design Effective Project Teams," itAIS, Italy . *Sprouts: Working Papers on Information Systems*, 8(44). <http://sprouts.aisnet.org/8-44>

# ICT, Creativity and Innovation. How to Design Effective Project Teams

B. Imperatori and R. Bissola<sup>1</sup>

**Abstract.** There are evidences, both from theoretical and managerial perspective, that team creativity is one of success factor for ICT innovative projects. This article focuses on the team design for ICT project, considering the relevance of the collective creative dimension. What is the relationship between individual and collective creativity? How to design and manage creative teams in ICT projects? We developed a wide research programme aiming at going deeper in creativity dynamics to understand what factors and which processes contribute to increase or reduce the creative performance at group level. According to our research aims and considering the review of the specific literature, we designed an experiment. Multiple measures of both individual and group creativity were considered. Results confirmed our main assumption: individual creativity is positively related with group creativity but it does not fully explain it. Moreover, individual creativity has different significant impacts on the three different collective creativity components. Finally, we suggest some practical guidelines for managing an effective creative ICT project team, to support the team members staffing and the group composition.

## Introduction

Several recent contributions identify social processes as a relevant success factor of project management and ask for future research as well as managerial guidelines about this topic [1, 2, 3]. Our research sets sights on the “people side” of ICT projects to answer some up-to-date questions to bridge some gaps still present in the creativity literature.

The development and implementation of ICT involve collective creativity processes. Three main evidences support this preliminary consideration. (a) IS and ICT core activities concern innovation; and creativity is defined as the initial phase of the innovation process [4]; (b) IS and ICT tasks are characterized by the

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lack of a-priori identifiable paths to the solution [5] and therefore the imply creativity capabilities; (c) IS and ICT development and implementation activities are usually organized in form of projects performed by multi-professional teams [6], and creativity is one of the success factor of a project.

These ICT activities features perfectly fit with the archetype of *responsive creativity* [7], a particular type of creativity that is externally driven in a closed-problem field: participants, according to specific requirements, are in charge to answer to a precise problem. This kind of creativity is also defined by the author *occupational creativity*, because it concerns professions that have a creative nature, such “ICT technicians” .

## Theoretical background and research propositions

Traditionally, creativity has been described as an individual characteristic and studies have focused primarily on personality traits associated with creative behavior, on cognitive factors, and on motivation [8, 9].

Interest in the collective dimension of creativity is more recent, coinciding with recognition of its strategic value in a business setting [10]. But literature on group creativity mainly concentrates on contextual or organizational conditions able to enhance creativity [11, 12] and little emphasis has been given to organizational design issues related to effective project team creative performance

Moreover, only few research projects consider the relationship between individual and collective creativity and they have some limitations that restrict findings comparison and generalization [13, 14]<sup>2</sup>.

This article aims at reducing these gaps. It focuses on the ICT project team design considering the relevance of the collective creative dimension.

There are evidences that creative collectives can produce higher creative results than the mere collection of individual creativity [12]. But, on which conditions? How to design and manage creative teams in ICT projects? Are high levels of individual creativity enough to guarantee a better group performance?

Given the state of the art of the literature and the aim of the article, we formulate the following research propositions.

- P.1** *Ceteris paribus*, the average individual creativity of a team is positively related to the group creativity, but the first does not fully explain the second one.
- P.2** *Ceteris paribus*, the various components of group creativity are differently related with the average individual creativity of the team.
- P.3** *Ceteris paribus*, the various interaction processes among team members contribute to explain the level of the group creativity.

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<sup>2</sup> For a more complete literature review on creativity see also references 15 and 16.

## Research variables and methodological design

Consistently with the literature analysis and in order to test our research propositions, we considered multiple measures of both individual and group creativity. Group creativity was measured considering the collective output and was operationalized as multiple variable according to Besemer and O'Quinn [17]. The three dimensions considered are: a) *novelty*, in terms of originality, b) *resolution*, in terms of how the product meets the expressed needs, c) *elaboration and synthesis*, in terms of general design [15]. Individual creativity was measured by multiple indicators from the psychological literature (both Williams and Torrance test – [18, 19]). Fluency, flexibility, originality, lateral and associative thinking are some of the considered dimensions.

We designed an experiment to analyse, *ceteris paribus*, the relationship between individual and team creativity. 737 undergraduate students attending courses of Organizational Design, HRM and Organisational Behaviour at Catholic University in Milan compose the research sample. They formed 67 eleven people-groups, which were in charge to perform a creative product. An observer was assigned to each group, to look at the process together with the two researchers (according to the Critical Incident Technique). Group creativity was evaluated by a jury of 12 students, two researchers and two “experts” (an architect and a psychologist). 820 people were totally involved. We also checked for some control variables (i.e. gender, age). At the end of the experiment, all the participants (including observers and the researchers) was asked to edit a semi-structured observation report to narrate their experience [20].

## Preliminary results

Overall results suggest some fruitful indications to better support creative processes through teams in high innovative projects, as ICT projects. The main evidence concerns team design and governance.

As mentioned, group creativity was measured according to the Besemer & O'Quinn scales [17]. To validate the scales, data on the 70 items were first synthesized in the 11 mid-factors all showing significant results of the related factor analysis models. In table 1 the synthesis factors and the explained variance of each model are shown. Using these 11 synthesis dimensions, a further factor analysis model was performed. The new model indicates three factors that correspond to the three elements of the output creativity: component 1 corresponds to novelty, component 2 to elaboration & synthesis, and component 3 to resolution. The model results (table 2) statistically demonstrate the significance of the three dimensions proposed by Besemer & O'Quinn, as a consequence of the collected data.

**Table 1.** Synthesis factors and the total variance explained

Items No.	Synthesis Factor	Total variance explained
9 items	ORIGINAL	85,95%
6 items	SURPRISING	86,96%
3 items	GERMINAL	87,7%
6 items	VALUABLE	67,1%
6 items	LOGICAL	82,43%
9 items	USEFUL	78,15%
8 items	ORGANIC	69,54%
5 items	ELEGANT	88,01%
5 items	COMPLEX	73,33%
6 items	UNDERSTANDABLE	72,18%
7 items	WELL CRAFTED	86,07%

The correlation table points to interesting connections among a number of the variables considered. First of all, group creativity has proven to be positively correlated with average individual creativity of the group, even though the intensity of the connection is not particularly high ( $\rho = 0.268$ ). Looking at the various components, the most significant correlation is between product novelty and average individual creativity ( $\rho = 0.307$ ). The correlation of elaboration & synthesis and resolution with average individual creativity is positive, but closed to zero and not statistically significant, considering ( $\rho < 0.1$ ). As for the control variables, the table shows a negative, although not significant, correlation between the year of birth of the participants and total group creativity ( $\rho = -0.234$ ). The index becomes negatively significant when looking at the dimension resolution ( $\rho = -0.248$ ). The index becomes negatively significant when looking at the dimension resolution ( $\rho = -0.248$ ).

The regression analysis shows (see Table 3) a significant positive relationship between individual creativity and group creativity. Specifically we obtained the following results: a). there is a positive and statistically significant relationship between the average individual creativity of the team and the group creativity, but with a low predictive power; b) the dimensions of group creativity (i.e. novelty, elaboration & synthesis and resolution) show different levels of significance: there is a positive and strong relationship between novelty and individual creativity with a still quite low  $R^2$  (0,162), and the significance of the regression model of individual creativity to resolution and elaboration is not relevant ( $t > 10\%$ ).

To go in deep, we performed a two-steps cluster analysis according with the following variables: average individual creativity of the group, individual creativity standard deviation of the group, overall group creativity, resolution, novelty, elaboration and synthesis. We identified four clusters. The first one is composed by low-creative people in a very homogeneous way. The second cluster collects

medium-creative people (on the average), but with a high variance within the group. The third cluster collects low-creative people also with a high internal variance. Finally, cluster four is composed by very homogeneous and high-creative people. Cluster analysis shows the cluster 4 is the best considering group creativity levels, with the exception of elaboration and synthesis (where the cluster 3 is the best performer). Cluster 2 is characterized by low creative performance with reference to all the group creative dimensions. Cluster 1 is the worst one. Surprisingly cluster 3 obtains the best performance for resolution and the second-best performances for elaboration & synthesis and novelty, even if it is composed by low-creative people.

The correlation analysis within each cluster suggests interesting consideration. As for correlation between average individual creativity and group creativity, cluster 3 has the highest value (0,373) with all the components of group creativity (i.e. novelty, elaboration & synthesis and resolution) having a positive correlation value. Cluster 1 is the second best for correlation between the two creativity levels (0,317), but looking at the components of group creativity, differences among their correlations with average individual creativity come to evidence. In particular, resolution is high related to the average individual creativity (0,566), whereas novelty is negatively correlated with it (-0,247). A positive even if lower correlation between average individual and group creativity is also the case of cluster 4 (0,169). Novelty and resolution are positively related with the average individual creativity, whereas the correlation with elaboration & synthesis is negative (-0,126). The correlation between average individual and group creativity is negative in cluster 2. As for the components, the lower correlation values with average individual creativity refer to novelty and resolution (-0,252 and -0,251).

**Table 2.** Factor analysis: rotated component matrix

	Component		
	1:	2	3
Factor Elaboration/Complex	.954	.103	
Factor Novelty/Original	.892	.164	.385
Factor Novelty/Surprising	.884	.195	.356
Factor Novelty/Germinal	.877	.187	.388
Factor Resolution/Useful		.977	.123
Factor Resolution/Logical	.180	.828	.480
Factor Elaboration/Organic	.242	.701	.623
Factor Resolution/Valuable	.517	.600	.540
Factor Elaboration/Elegant	.543	.243	.783
Factor Elaboration/Understandable	.246	.547	.746
Factor Elaboration/Well crafted	.464	.503	.688

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 5 iterations.

## Conclusions

This article is part of a wide research program on organizational issues about group creativity within high innovative projects, as ICT ones. In this paper we analyzed the relationship between individual and group creativity. Our data shown that individual creativity does not fully explain group creativity. This conclusion confirms our proposition n. 1 and opens a new research agenda on social processes that are behind group creativity. Moreover, our research design includes articulated creativity measures both at individual level, and group level, that allowed us to compare the influence of individual creativity on different group creativity components (novelty, elaboration & synthesis and resolution). The results confirm our proposition n. 2, about different relationships among various creativity components, both at group and at individual level. Specifically, data demonstrate that group novelty is strongly related to individual creativity, otherwise group elaboration & synthesis are less influenced by individual creativity, and group resolution is nearly independent. Such considerations open up to the next part of our research agenda, which assume that social dynamics probably intervenes in collective processes thus contributing to determine group creativity results (proposition n. 3). Cluster analysis made evident that intervening processes has a broadening effect on individual creativity, and proving that joint a group could be advantageous in particular for certain kinds of people. Results suggest that the most creative and homogeneous groups seem to obtain the main advantage from the collective interaction, in particular with reference to novelty and elaboration & synthesis. But – more surprisingly, positive effects also concern groups characterized by a low average individual creativity and a high level of internal variance. These groups were the best for resolution and obtained an high score for elaboration and synthesis too. Finally, with reference to the organizational and interpersonal dynamics, we took into consideration the semi-structured survey completed by observers and participants and, in an exploratory way, we identified five categories of intervening processes, that seems to have a relevant influence on the overall group creativity: communication processes, leadership processes, processes of interpersonal collaboration and trust, emerging processes of structuring group activities and roles, cognitive processes, motivational processes, diversity processes.

All these evidences allow us to formulate some practical guidelines, useful for staffing practices for ICT project team. First, our research underline the relevance both of creative and social competences for each team member, to enhance overall group creativity in a high level innovative ICT project. This means that an effective selection process has to be design also to assess individual behavioral competences, not only technical and creative ones. Second, according to the creative group level attended, it is possible to differently compose a project team. High degree of overall creativity are possible with a team composed both by high homogeneous creative members, and by less creative members, and a strong creative



leader. Higher level of resolution are possible in the second team structure, higher level of novelty are more probable in the first team structure.

The next step in data analysis will concentrate in particular on the interaction analysis of such processes with collective creativity so that some insights on the influence of organizational and group dynamics is provided.

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**Table 3.** Regression models synthesis

Dependent variable	Predictors (input)	R Square	Global Statistical significance Model	Standardized Coefficients	Statistical sig. coefficient
Group Creativity	Individual Creativity (avarage group) Individual Creativity (group std dev) Birth year (group average) Brain Right % Female	12.3%	sig. F< 5%	Individual Creativity (avarage group) 0,2608 Birth year (group average) -0,2265	sig. t<5% sig. t<6%
Factor Novelty	Individual Creativity (avarage group) Individual Creativity (group std dev) Birth year (group average) Brain Right % Female	16.2%	sig. F< 1%	Individual Creativity (avarage group) 0,3506 % Female -0,2638	sig. t<1% sig. t<5%
Factor Resolution	Individual Creativity (avarage group) Individual Creativity (group std dev) Birth year (group average) Brain Right % Female	6.2%	sig. F< 5%	Birth year (group average) -0,2483	sig. t<5%
Factor Elaboration	Individual Creativity (avarage group) Individual Creativity (group std dev) Birth year (group average) Brain Right % Female	5%	sig. F= 6.9%	Birth year (group average) -0,2236	sig. t= 6.9%

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